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BEHAVIORAL TECHNOLOGY LABORATORIES

FINAL REPORT

RESEARCH ON SELF-DIRECTED LEARNING TO MEET JOB PERFORMANCE REQUIREMENTS

February 1979

Allen Munro and Douglas M. Towne

Sponsored by

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This is the Final Report for Contract N00014-77-C-0328, covering a period of two years from February 1977 to February 1979. The last three months of this period was provided through a three-month no-funds extension to the original contract. Research was conducted primarily in two areas of cognitive strategies for on-the-job training (OJT). The first area was the development and testing of a training system to improve selectivity in text processing in order to improve performance during OJT. The second area was

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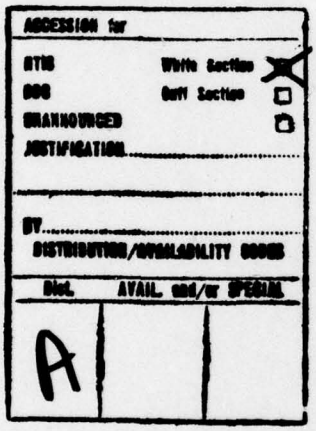
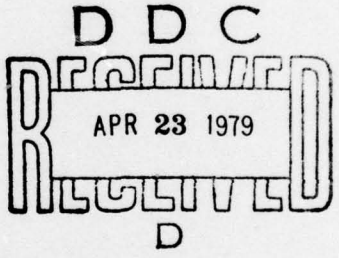
In addition to producing computer programs for training in selective text processing, the BTL staff also produced four technical reports, two chapters in books, and three papers for professional meetings.





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ABSTRACT

This is the Final Report for Contract N00014-77-C-0328, covering a period of two years from February 1977 to February 1979. The last three months of this period was provided through a three-month no-funds extension to the original contract. Research was conducted primarily in two areas of cognitive strategies for on-the-job training (OJT). The first area was the development and testing of a training system to improve selectivity in text processing in order to improve performance during OJT. The second area was the exploration of text type effects on learning from text. Preliminary results from this research suggest that learning from text may be measurably improved through the application of text processing techniques appropriate to the type of text being read.

In addition to producing computer programs for training in selective text processing, the BTL staff also produced four technical reports, two chapters in books, and three papers for professional meetings.

ACKNOWLEDGEMENTS

Joseph W. Rigney conceived of the research program described in this report. His death on September 25, 1978 was a great loss to all who had worked with him and to scholars in his fields of research. We at Behavioral Technology Laboratories owe great debts--intellectual, professional, and personal--to Joe Rigney.

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Other Behavioral Technology Laboratory staff members also made important contributions to the work of this contract, including Donald Crook, Lynn Gordon, Kathy A. Lutz, and David Werner.

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RESEARCH ON SELF DIRECTED LEARNING TO MEET JOB PERFORMANCE REQUIREMENTS

I. INTRODUCTION

This report covers a period of two years, from February 18, 1977 to February 28, 1979. The last three months of this period was provided through a three-month no-funds extension of the contract. The research undertaken was motivated by a concern over the ineffectiveness of technical documentation for communicating the information used by technical personnel to maintain and repair equipment in the Navy. This problem has been attacked by other researchers by investigating the effects of changes in the documentation. Research has been conducted on readability of manuals versus reading level of recruits, improvements in manual format, the use of word processing systems, and compression of information into small volumes (such as microfiche or holograms) in order to improve storage and retrieval. The approach undertaken in this contract has been to seek means for improving the effectiveness of personnel in using documentation. Two approaches have been pursued. The first resulted in the development and testing of a computer-based training system to improve selectivity in text processing. The second approach was to explore the effects of different types of texts on readers' memories for the texts.

During the period of the contract, four technical reports, two chapters in books, and three papers for professional meetings were produced. In addition, computer programs for teaching selective learning techniques were

developed and tested. Evaluations of these programs were conducted with the participation of Naval Reserve Officer Training Corps students.

The progress of the research undertaken for this contract reflects a growing concern for the importance of studying the basic cognitive processes responsible for successful learning from texts. Although initial efforts to develop a computer-based system to improve self-directed learning from text met with moderate success, many of the phenomena observed during the experimental evaluations prompted a concern with more basic issues. One such issue is whether the replacement of an inefficient but well-learned, unconscious, strategy for learning with a technically more efficient but less well-learned strategy will actually result in the improvement of performance. Well-learned, "automatized" processes tend to conflict with consciously executed strategies in some contexts. More work needs to be done to determine under what circumstances a conscious strategy will result in superior performance relative to an inherently inferior automatic process. In addition, research is called for to determine what variables control the amount of training required for the automatization of a learning strategy or process.

A second issue which emerged from the first research efforts reported here is the effect of text type on learning from text. Pilot experiments and informal observations suggested that there were important differences among texts (beyond the usually noted differences in word frequency and syntactic complexity) that could affect understanding of and memory for the content of the texts. It was hypothesized that a psychological variable called <u>text type</u> could be associated with texts. The value that a given text has on the text type dimension was expected to affect the way in which

the text would be grouped with other texts, how well the information in the text would be remembered, and so on. A variety of experiments were conducted and their results convincingly support these hypotheses. The significance of this result for training to meet job performance requirements is twofold. First, it is possible that the text type variable may be manipulated in such a way as to improve readers' memories for the information conveyed by a text. Second, pilot results suggest that different reading strategies may be differentially effective at promoting memory for the content of the texts of different types. Further research is called for if these findings are to be applied to improve self-directed learning to meet job performance requirements.

II. AN EXPERIMENTAL SYSTEM TO IMPROVE SELECTIVITY IN TEXT PROCESSING

Military tasks, such as troubleshooting complex electronics equipment, often require the use of texts, such as technical manuals. In many cases, far more information is available in the text than is needed for the accomplishment of the task at hand. The purpose of this research was to develop a computer-based instructional system to teach self-directed, selective reading skills. The approach taken was to develop a computer program that provides automated aids to this kind of self-directed learning. One of these functions of this aids system was to promote a careful job analysis, including the formulation of reading objectives relevant to the job task at hand. Another function was to permit the student/user to create a task-specific list of portions of the text, and to require that these be related by the student to specific objectives. The aids system also maintained a record for the use of the student of his or her progress in understanding relevant text portions and accomplishing objectives. The structure of the aids system was designed to promote conceptually-driven processing in the use of texts in job-related tasks. An experimental test of the first training system was conducted in October-November, 1977. The findings of this study, including the comments given by student participants, were used to develop a new training system. The new system was constructed to further emphasize conceptually-driven aspects of selective text processing, and new memory aids were provided for the student. In addition, aspects of the training system were improved on pedagogical grounds. An experimental test of the new system was conducted in April-May, 1978. Students' performances were evaluated on several measures of selectivity and on

the quality of their planning, as well as on the overall efficiency of their troubleshooting performances. In addition, the student's written summaries of their self-reported strategies for selective text processing were evaluated in terms of a schema-theoretic model of the selective text-processing skills of an ideal reader.

The results of these experiments suggest that readers can be taught to make more effective use of texts through the application of selective processing procedures. However, the results also suggest that retraining basic text processing techniques may be a time-consuming and expensive process, relative to the amount of improvement in learning from texts that is brought about. Informal observations of student behavior in these experiments suggested that the lines of research described under III, below, would be a more effective means of improving self-directed learning from text.

Work in this area was carried out from February of 1977 to September of 1978. Two technical reports, two chapters in books, and one paper prepared for a professional meeting describe the results of this research.

Technical Report No. 84

Allen Munro, Joseph W. Rigney, and Donald E. Crook A formative evaluation of a computer-based instructional system for teaching job-oriented reading strategies. January 1978.

On-the-job training requires considerable independence on the part of the trainee. Unlike a student in a classroom, the trainee must arrange information resources in such a way that he can learn how to perform his specific task without wasting valuable time reading irrelevant information. He must further direct this learning himself.

A computer-based aid to self-directed learning has been developed to meet this need. This aids system is implemented on the PLATO system and uses the touch-panel capability of the PLATO-IV terminal. Students are presented with a task which requires complex learning, and they are given considerable information--much more than is needed, in fact--to attain the task. The aids system is designed to allow students to break down their task into a set of more easily attained objectives, to decide when information is relevant to their objectives, and in general to monitor their progress toward achieving the task.

The complete training aid is quite complex, so that students are trained in its use over a number of sessions. New features of the system are introduced in alternate sessions, and students then practice with the system using a new learning task. This task in each case requires the student to troubleshoot or debug a simulated device. This device produces output, some of which is defective, and the student is required to locate the faulty component by examining the defective output and by reading an on-line "technical manual" for the device.

A pilot experiment has been completed to allow a formative evaluation of the self-directed aids system. Although the results of this experiment found no statistically significant differences between the treatment groups, they suggested directions for future research.

Technical Report No. 88

Donald E. Crook, Allen Munro, Joseph W. Rigney, and Kathy A. Lutz
A computer-based training system for selective text processing.
August 1978.

Self-directed learning is that type of learning which is not structured for the student by an instructor. Instead, the student must structure his learning himself by making decisions about which materials are relevant to his learning goals, which materials require the prior understanding of which other materials, and so on. A computer-based system has been developed to train students in this type of learning.

A revised system based on an earlier version of a computer-based self-directed learning system was developed. The improved system described herein contains features designed to make it easier for students to use. In addition, pedagogical features of the training system have been improved, to give students an opportunity to learn the system completely.

An experimental test of the improved system was designed to separate out the effects of training in self-directed learning from the use of the system itself. Data were collected on four different measures of learning: effective learning, selective learning, planning, and verbal report. Results of the experiment found that there were no significant differences among treatment groups in the performance data (the first three learning measures), even though one of the experimental groups outperformed the other groups in every measure. On the measure of verbal report, however, this experimental group performed significantly better than did the control group.

III. EFFECTS OF TEXT TYPE ON LEARNING FROM TEXT

Work on text type phenomena was conducted from October of 1977 to the end of the contract. The results of the research are described in two technical reports and two papers delivered at professional meetings.

This research was prompted by the informal observation that readers' memories for texts seemed to be determined not only by levels of lexical and syntactic complexity, but also by the type of the text. Work was conducted on the structural and semantic features of three types of texts: simple narrative stories, definitional explanations, and instructions. A variety of characteristic differences on both semantic and structural dimensions were observed. It was hypothesized that these differences would result in differences in the amount of information that could be recalled from texts of different types. Several experiments were conducted to test this hypothesis, which was, in general, well supported by the data. Analysis of students' recalls also revealed that the extent of reordering of the information in texts seemed to be a function of text type. In another experiment, it was shown that text type is a powerful determiner of subjects' responses to a sorting task. A clustering analysis of text sorting data bears out the text type assignments proposed for particular texts. Taken together, these results argue for the psychological validity of a text type variable.

One intriguing and unexpected result of this research was the discovery that different text processing techniques seem to be differentially effective for texts of different types. Specifically, it was found that when students are restricted to a single exposure to texts, they recall more of the content

of instructions than of definitional explanations. However, if students are required to reread and produce written summaries of the texts, they recall more of the content of definitions than of instructions. These results suggest that memory for different types of texts may be improved through the application of different strategies--a different strategy may be ideal for each type of text. Further research is called for to establish this claim, and, if results warrant, to apply the findings to a system for improving learning from texts of different types.

Technical Report No. 85

Lynn Gordon, Allen Munro, Joseph W. Rigney, and Kathy A. Lutz, Summaries and recalls for three types of texts. May 1978.

SUMMARY

A theoretical orientation for the study of different types of texts is presented. Schema theory is proposed as a useful metatheory within which to develop specific theories about reading. Both theories about the processes of reading and theories about the structure of what is read can be readily formulated in schema theory terms. It is proposed that readers make judgments about the types of texts that they read and that these judgments bring about the activation of expectations with respect to the structure and meaning of these texts.

Previous work on the structure of texts, primarily for simple narratives, is reviewed. Problems with earlier formalisms and scoring methods are discussed, and heuristics for avoiding these problems are presented.

Three types of texts were selected for study. One type was the simple short story, a type closely related to (and, in some cases, identical with) the kinds of texts studied by other researchers. The second type studied were instructions. The third type was definitional explanations, a type well characterized by popular science articles. Detailed analyses of the text structures and text semantics for eight texts (three stories, two instructions, and three definitions) are presented. Texts of the different types differ from each other in consistent ways on two dimensions. First the text structures of definitions tend to be organized horizontally rather than vertically, as are the text structures of stories and instructions. Second, the semantic representations of stories are composed of specific concepts, in schema theory terms, while the semantic representations of instructions and definitions consist primarily of generic concepts. On the basis of these differences among the texts, we predicted that stories would be better remembered than definitions. Three experiments were conducted to test this hypothesis.

In Experiment One, subjects read and summarized six texts and later recalled three of these texts. Analysis of the summary data indicates that texts of different types are summarized to about the same extent. The recall data, however, suggests that text type may determine the amount recalled. Analysis of the recall data showed that, although stories were remembered best (as had been predicted), the propositional content of definitions was remembered better than that of instructions. It was hypothesized that rereading and summarizing may have had a differentially facilitative effect for later recall, benefiting the recall of definitions more than instructions.

In order to test this hypothesis, Experiments Two and Three were performed. Subjects heard tape recorded texts (in Experiment Two the same set of texts used in Experiment One; in Experiment Three a somewhat different set), and, after performing a brief interfering task, recalled each text after hearing

it. They were therefore not able to reprocess texts as they had been able to in Experiment One. In general, the results of these experiments confirmed our predictions: stories were recalled better than instructions, which, in turn, were recalled better than definitions. Subjects' recalls in these experiments were also scored for the amount of reordering of the textual material. This analysis showed a very powerful effect due to text type. Recalls of definitions showed significantly more reordering than did recalls of instructions, which, in turn, had more reordering than did the recalls of stories. These results are also in accord with our theory that stories have more hierarchical, differentiated text structures than do instructions or definitions, and that definitions have less hierarchical structures than do instructions.

Subjects in these two experiments were also requested to cluster the texts in natural groups according to their types, as they perceived them. Their groupings were remarkably consistent with our own classifications.

The research presented demonstrates the need for a more thorough investigation both of the nature of people's expectations for differences in different types of text, and of the effects of such expectations on understanding and memory. Further research is also needed to explore the hypothesis that texts of different types may benefit differentially from the application of particular learning strategies, such as rereading and summarizing.

Technical Report No. 91

Allen Munro, Kathy A. Lutz, and Lynn Gordon On the psychological reality of text types. February 1979.

SUMMARY

Text type is proposed as a psychologically valid construct. Previous research has suggested that text type may play a role in a reader's comprehension of and memory for a text. Two experiments were conducted to explore the psychological reality of text types. In the first experiment, students were required to sort twelve texts on the basis of their similarities. The resultant sortings were subjected to a clustering analysis. Despite the fact that other bases for grouping together texts existed--a number of pairs of semantically related texts of different types were included--text type emerged as a powerful determiner of group membership. In the second experiment, students listened to recorded texts and then tried to recall them. As was predicted, text type had a significant effect on recall, with stories being recalled more fully than were instructions or definitions.

IV. RECOMMENDATIONS

Both of the areas of research pursued under this contract have the potential of producing products useful to the armed services. Further research in two areas is called for before such products can be developed, however. The first of these areas is that of the automization of learned behaviors. Decisions about the adoption of training programs designed to replace old, well-learned, inefficient procedures with new, more efficient procedures cannot be made rationally without knowing more about the costs (in time and training effort) of making the new strategy an effective automatic response in the trainee.

The second area of research suggested by the findings of this contract is that of text type studies. Much of the psychological research currently being conducted on reading makes extensive or even exclusive use of narrative text stimuli. The findings of the research conducted under this contract suggest that such findings may not be applicable to the cognitive processes that are called for in the tasks of processing more technical kinds of texts, such as are most often used in military jobs. Further basic research is called for to determine the breadth of text type effects. In addition, results of the research conducted thus far suggest potentially profitable directions for applied research on type-specific text processing strategies.

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